APPENDIX C - GEOLOGIC AND SESMIC CONDITIONS AT BULL RUN FOSSIL PLANT

Geologic and Tectonic Setting

Bull Run Fossil Plant is located in the Valley and Ridge physiographic province. The Bull Run Fossil Plant site is underlain by four geologic units of sedimentary rock that have Cambrian and Ordovician ages. These units are, from oldest to youngest, the Rome Formation, the Conasauga and Knox Groups, and the Chickamauga Limestone.

The Valley and Ridge physiographic province is located within the North American crustal plate, far removed from any tectonic activity occurring at boundaries of the Earth's crustal plates. Most of eastern North America is characterized by a maximum compressive stress that lies near horizontal and is oriented generally east-northeast to west-southwest (Zoback and Zoback 1991). This type of stress regime results in strike-slip and thrust faulting on fault planes that are favorably oriented to the direction of the maximum compressive stress.

Regional Earthquake History

Figure C-1 (CNSS 1999) shows the earthquake activity within 300 km of Bull Run fossil plant from 1964 through 1998. Regional seismograph networks were used to determine most of these earthquake epicenters and their associated magnitudes. The band of earthquakes from northeastern Alabama to southeastern Kentucky shown in Figure C-1 comprise the East Tennessee Seismic Zone.

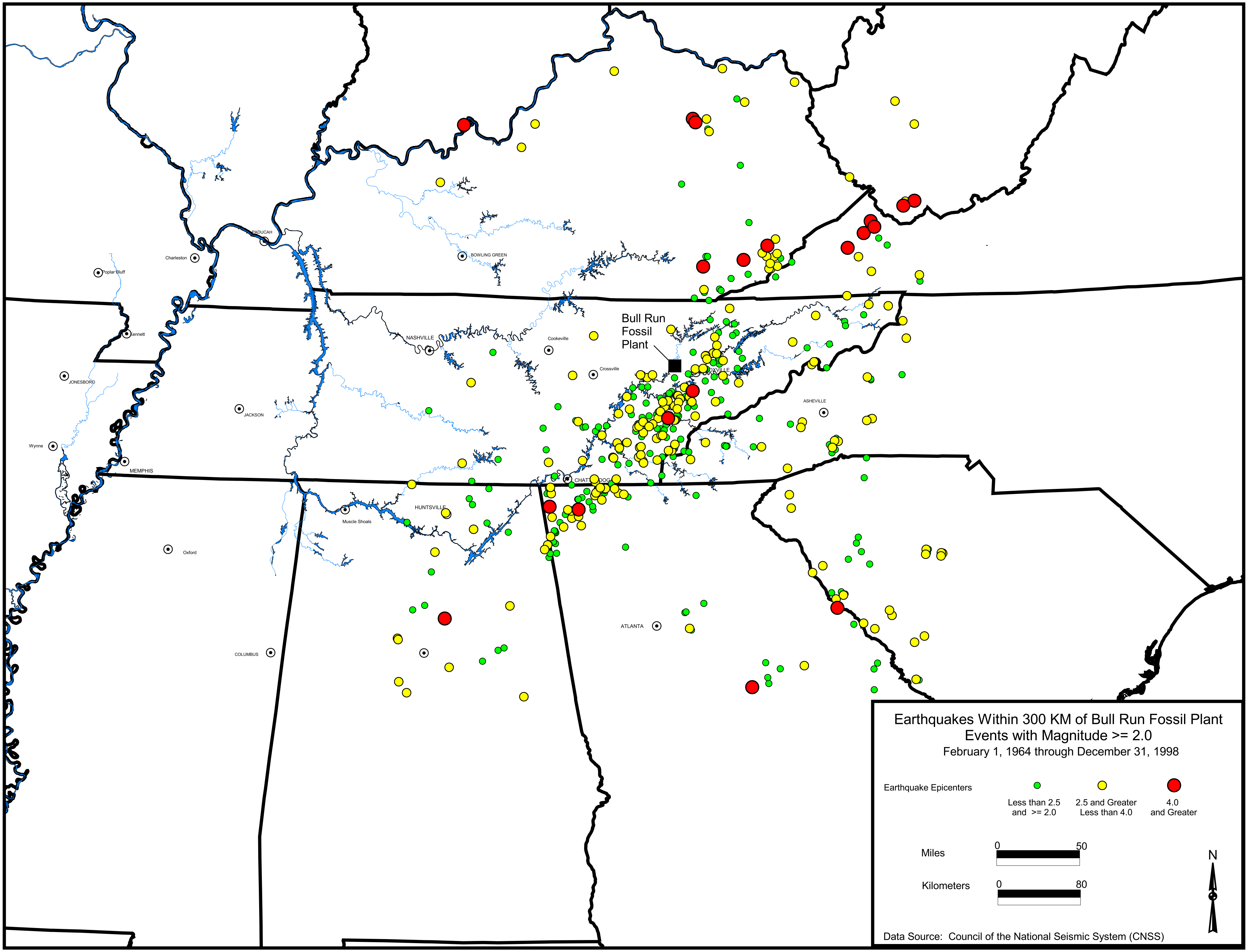
The East Tennessee Seismic Zone (ETSZ) is a 300 km long, northeast-southwest trending concentration of earthquakes that has been well delineated in recent years by regional seismograph networks (Powell, et al., 1994). In recent years, except for the New Madrid Seismic Zone, the rate of earthquake activity in the ETSZ has been higher than any location in the United States east of the Rocky Mountains.

Assuming that present rates of seismic activity continue throughout the region, the seismic hazard at the project site will be dominated by earthquakes occurring within the East Tennessee Seismic Zone, particularly the portion of the ETSZ near Bull Run Fossil plant (USGS 1996 -- seismic hazard deaggregation maps for Knoxville, Tennessee).

Ground Deformation Potential and Effects of Soils

Faults and shear zones are common at BRF in association with the Copper Creek Fault which crops out along the northwest flank of Bull Run Ridge (Julian and Danzig 1996). The Copper Creek and associated faults were formed many millions of years ago. Further movement along these faults is not expected because modern day earthquakes in East Tennessee tend to occur several miles beneath the surface and no recent movement has been observed on other surface faults in East Tennessee.

The strength and thickness of soils strongly influence the amount and type of shaking a structure is subjected to during earthquakes. Generally, sites founded on soft rocks and soils experience much stronger shaking than sites founded on competent, hard rock. No information was available on soil strength at BRF. Structures founded in competent rock at this site have foundation conditions corresponding to ICBO (1997) seismic site category A or B.



Earthquakes Within 300 KM of Bull Run Fossil Plant
Events with Magnitude >= 2.0
February 1, 1964 through December 31, 1998
Earthquake Epicenters
Less than 2.5 and >= 2.0
2.5 and Greater Less than 4.0
4.0 and Greater
Miles
0
50
Kilometers
0
80
N
Data Source: Council of the National Seismic System (CNSS)
Bull Run Fossil Plant
PADUCAH
Charleston
Poplar Bluff
Kennett
JONESBORO
JACKSON
Wynne
MEMPHIS
BOWLING GREEN
NASHVILLE
Cookeville
Crossville
ASHEVILLE
HUNTSVILLE
Muscle Shoals
Oxford
COLUMBUS
ATLANTA

Seismic Hazard Assessment

The earthquake hazard at a site can be modeled probabilistically by considering all seismic source zones around a site, and the probability that these source zones will produce earthquakes of various sizes. The U.S. Geological Survey (USGS) performed probabilistic seismic hazard analyses throughout the United States to prepare the 1996 national seismic hazard maps (United States Geological Survey 1996). The USGS's analysis assumes that foundation conditions correspond to NEHRP B-C site conditions. The hardest rock conditions are category A and the softest soils fall in category F on this scale.

Table C-1 presents the USGS's seismic hazard values for a point (36.00 deg N, -84.20 deg W) that is very near the Bull Run Fossil Plant (36.02 deg N, -84.15 deg W) location. The USGS expresses seismic hazard as the minimum horizontal ground motion that would be expected to occur during three time spans (return periods): 475, 950 and 2375 years. The ground shaking is computed at four different frequencies of motion: PGA, 5.0, 3.3 and 1.0 Hertz. In the same way that the "100 or 500 year flood" means the level of flooding expected to occur at least once during those periods of time, ground shaking return periods refer to the minimum level of ground shaking expected during the specified time. In this case, Table C-1 shows that at a frequency of 1.0 Hertz, the ground should shake with a force of at least 6.0% g once in 475 years (g is the acceleration of a falling object due to gravity). The 475 year return period is equivalent to a 1 in 10 chance that the ground shaking will be exceeded in only 50 years.

Table C-1 Probabilistic Ground Motion Values

	Ground Accelerations in %g		
Ground Motion Frequency (Hertz)	**10% Probability of Exceedance in 50 yr**	**5% Probability of Exceedance in 50 yr**	**2% Probability of Exceedance in 50 yr**
	(475 year return period)	**(950 year return period)**	**(2375 year return period)**
Peak Ground Acceleration	9.0	15.1	28.3
5.0	18.2	28.7	53.4
3.3	14.1	22.7	39.4
1.0	5.5	8.7	14.2

Source: USGS 1996

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Glossary

Deaggregation - In probabilistic seismic hazard analysis, deaggregation refers to breaking the sum of the hazard calculation into its components. Deaggregation is often used to determine what earthquake scenario input (for example, magnitude-distance pair) contributes the most to the overall earthquake hazard at a site.

Liquefaction - the sudden large decrease of the shearing resistance of a cohensionless soil, caused by a collapse of the structure by shock or strain, and associated with a sudden but temporary increase of the pore fluid pressure. It involves a temporary transformation of the material into a fluid mass.

Regolith - the layer of loose or unconsolidated rock material that forms the surface of the land and overlies more coherent bedrock.

Saprolite - a soft, clay-rich, thoroughly decomposed rock formed in place by chemical weathering.

Standard Penetration Test - a geotechnical method used to determine soil conditions. This test involves driving a split-barrel sampler 18 inches into the soil at the bottom of a boring, then counting the number of blows (the N number or value) to drive the tube 12 inches using a 140 lb. mass falling a distance of 30 inches.